

The effect of material and information decoupling points on supply chain collaboration

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Abstract

The paper seeks to investigate the effect of the location of material and information decoupling points on the nature of supply chain collaboration. In order to achieve this goal, the relationships between the location of the two types of decoupling points are identified and necessary dimensions of collaboration recognized. The theoretical considerations are then evidenced by cross-sector findings of the empirical study conducted in supply chains.

Keywords: decoupling point, integration, supply chain

Introduction

Supply chains possess two constituting flow pipelines – product transfer pipeline and information transfer pipeline. One may identify a material decoupling point in the product transfer pipeline, whilst an information decoupling point might be recognized in the information transfer pipeline. In general, material decoupling point refers to the physical allocation of the goods and indicates how deeply the customer order penetrates into the physical flow (Hoeks-tra and Romme 1992). Therefore, material decoupling point is a buffer between upstream and downstream partners in the supply chain. The upstream links are protected from varying consumer buying behaviors and may establish smoother upstream flow of products, while downstream consumer demand is still met via a product pull from the buffer stock (Mason-Jones and Towill 1999). On the other hand, information decoupling point is where information turns from the high value actual consumer demand data to the typical upstream distorted, magnified and delayed order data (Mason-Jones and Towill 1999). Demand information constantly suffers from a delay and distortion as it moves through supply chains. Therefore, in order to increase a number of companies which have direct, actual and on-line demand information from the market, it is recommended to locate information decoupling point as far upstream as it is possible (Mason-Jones and Towill 1997).

An appropriate location of material and information decoupling points is one of the most pivotal aspects of effective supply chains. The placement of these points may have a significant impact on the nature of supply chain collaboration, determining the way the physical flow in a product pipeline transfer is managed.

The paper seeks to explore the effect of the location of material and information decoupling points on the intensity of supply chain collaboration. In order to achieve this goal, the following structure of the paper has been employed.

Following the introduction, the idea of an integrated framework of material and information decoupling point is explained. Based on these considerations, the nature of supply chain collaboration regarding derived decoupling zones is demonstrated. In the next part of the paper, the methodology of an empirical study conducted in a sample of European supply chains is revealed. The findings derived from the analysis are presented and discussed. Finally, the conclusions of the research are drawn and the implications for further empirical studies are indicated.

The concept of material and information decoupling point – an integrated framework

Although, the concept of material and information decoupling is widely and profoundly investigated, it still lacks of integrated recognition. There are many theoretical considerations on the interpretation and the essence of material and information decoupling points as well as documented empirical studies on determinants of their location (Pagh and Cooper 1998). Many researches also employ these findings in their own studies regarding the issue of postponement and mass customization (Amaro et al. 1999; Anderson 1997; Blecker and Abdelkafi 2006). However, all investigated aspects of the concept are usually concentrated separately on material or information decoupling point rather than being combined and analyzed together. This tendency has a far more reaching consequence for empirical research which are more focused on investigation of the concept of material decoupling point (Mason-Jones and Towill 1999) which is evidenced to have a greater impact on supply chain efficiency and responsiveness (Gavirneni et al. 1997).

Employing an integrated approach for both decoupling points is strongly recommended in literature. For instance, Braithwaite (1993) highlights the triviality of individual and independent examination of material and information decoupling points by giving a substantial example of a company which did not develop integrated approach for both points. In the same vein, Mason-Jones and Towill (1999) allege that although material and information decoupling points are separate entities, they should be recognized together in order to fully achieve performance improvements in supply chains. In other publication, the Authors confirm that material flow coupled with open information channels will potentially have a much greater impact on supply chain competitiveness (Mason-Jones and Towill 1998). Billington and Amaral (1999) have suggested that the combined effect of the appropriate location of material and information decoupling points in supply chains can significantly improve responsiveness. Usually, when combining the location of material decoupling point with the position of information decoupling point one may usually distinguish between two or three zones. From the theoretical perspective when considering the relationship between the locations of material and information decoupling points, one may also identify only one zone when the points are located at either extreme upstream or extreme downstream position in supply chains. However, this situation is very rare and unusual in practice, therefore it is not considered in a further part of the paper.

As pull activities are based on the real market data, information decoupling point cannot be positioned downstream from material decoupling point. If material and information decoupling points are both in the similar locations in supply chains, two zones may be identified. It means that all companies in a supply chain having an access to the real customer data seize

this opportunity and perform their operations in a pull driven system. The remaining option represents 3 zones obtained through the different location of material and information decoupling points in supply chains. This situation is very common for contemporary supply chains. It demonstrates an essence of the integrated framework and indicates that both material and information decoupling points are inextricably linked. Companies in zone 1 do not receive any demand information from the market. The activities are push driven which means they are based on forecasted demand and sales plans. In the middle zone 2, companies receive real customer data from the market. However, it is not available on time to perform pull driven operations in the physical flow. Market information is mostly used to improve demand forecasts and enhance the operating capabilities from the perspective of physical efficiency (Olhager et al. 2005). Therefore, the aim of the companies in zone 2 is to run replenishment process upstream material decoupling point at low cost in order to provide a high service level for the links placed downstream from material decoupling point. An access to the real customer data enables to identify the whole value stream in supply chains, treated as the sequence of activities from the first link to the final consumer, and eliminate or avoid non-value adding processes (Piercy et al. 2002). The firms in zone 3 have an access to the real customer data and perform their operations in accordance with a pull driven system. Instead of the physical efficiency, which is less important here, the market responsiveness is rising to prominence in the third zone. Therefore, the links in the third zone pay attention to customer order variability, flexibility, greater use of IT and establishing virtual arrangements. M. Christopher et al. (2004) highlight that an important prerequisite to be more agile is a high level of shared information. In particular, there has to be a clear visibility of downstream demand. It means that data on real demand has to be captured as far down the chain as possible and shared with upstream partners.

The nature of supply chain collaboration in decoupling zones

Companies in the three zones in supply chains have numerous aims, perform push or pull driven activities, apply different approaches focused on efficiency and responsiveness. It all requires to establish collaborative relationships between companies in supply chains. The appropriate location of decoupling points is determined by the change of companies' attitude from taking individual and particular actions toward cooperation and achieving common, inter-organizational goals. However, the nature of collaboration in supply chains may vary depending on decoupling zones.

The majority of studies on supply chain collaboration is concentrated on the dimensions of relationship quality, its antecedents and consequences (Min et al. 2005), and performance (e.g. Lee et al. 1997; Lummus et al. 1998; Swink and Nair 2007). Yet Kannan and Tan (2010) allege that given the supportive evidence of a positive association between the relationship quality and performance, the current focus is explicitly on the other dimension of collaboration concerning its extent between supply chain partners. This was noticed by O'Leary-Kelly and Flores (2002) who acknowledged that supply chain collaboration expresses the extent to which supply chain members cooperate together in order to achieve a mutually beneficial goals.

Supply chain collaboration involves working together/jointly to bring resources into a required relationship and to achieve effective operations in harmony with the strategies/objectives of supply chain parties, thus resulting in mutual benefit (Spekman et al. 1998). Stevens points out that collaboration of this nature is more than a change of scope; it is a change away from the adversarial attitude of conflict to one of mutual support (Stevens

1989). Similarly, in the opinion of Pagell (2004) and Flynn et al. (2010), supply chain collaboration is a strategic establishing of both intra-organizational and inter-organizational processes.

In supply chain collaboration the partners are concentrated on a strategic vision of the future rather than on near-term planning and tactical execution (Cohen and Roussel 2005). This kind of relationships moves beyond supply chain operations to include other critical processes or a set of different functions (e.g. logistic, marketing, production). Therefore, supply chain collaboration may be described as managed business process links (Lambert et al. 1998), giving the priority in allocating scarce resources to this type of critical links.

An access to the real customer data enables the companies located in zone 2 and 3 to establish collaborative relationships in supply chains. However, it is not just an exchange of information on demand and inventory but also multiple collaborative working relationships across supply chain links on all levels. Companies tend to establish partner development cross functional teams intended to interface with the equivalent customers management team (Lewis 1995).

Methodology

Sample and data collection

In order to investigate the effect of the location of material and information decoupling points on the nature of supply chain collaboration, an exploratory study using a quantitative survey as a method of data collection was conducted.

The main research instrument used for this study was a questionnaire consisting of several sections examining the nature of supply chain collaboration from the perspective of material and information decoupling points. The set of data collected within the first release of the survey was gathered in European supply chains. For the purpose of the research presented in this paper, a group of relevant variables has been selected.

Firstly, the number of 48 comprehensive items, measured by a five-point Likert scale, constituted the list of initial variables identified on the basis on the literature review (Akintoye and Main 2007; de Leeuw and Fransom 2009; Lambert et al. 1996; Mentzer et al. 2000; Spekman et al. 1998). They concerned the quality of established relationships among supply chain members involving the level of trust and commitment in achieving a goal, common investments and gathering necessary data on supply chain partners, the contribution of collaboration in the success of a supply chain.

Sample was compiled from the surveys of manufacturing and trading companies operating in supply chains, and consisted of 260 organizations. Those firms were leaders or major links located upstream, in the middle or downstream in their supply chains established by at least three subsequent links.

The majority of the surveyed firms (65 percent) are trade companies, remainder of a research sample includes manufacturers. The prevailing share of the companies operate in wholesale and retail grocery sector (13 percent), fabricated metal products, industrial and commercial machinery sector and manufacturing of motor vehicles (a total of 12.5 percent), followed by the companies from a mining industry (8 percent), trading companies (selling cross-industry products, mainly household goods – 6 percent, clothes – 5 percent, chemicals – 4 percent, electronic equipment – 3%).

The prevailing share of 68 percent of a sample employed up to 9 people, followed by 17 percent of the companies employing from 10 to 49 persons. Much smaller share of 9 and 7 percent of a sample belonged to the companies employing from 50 to 249 and above 250 people respectively.

Research outline and statistical analysis

In order to address the goal of the paper, Principal Component Analysis (PCA) with Varimax Rotation was employed. It enabled to reduce many variables manifesting the nature of supply chain collaboration and, hereby ease the interpretation process through highlighting the main underlying multi-item constructs.

The preliminary analysis conducted on the variables manifesting the intensity of supply chain collaboration confirmed that in order to develop a strong structure of constructs, a group of 10 variables has to be dropped for low correlation indices with other variables. Principal Component Analysis conducted in a space of the remaining variables showed a clean factor-loading pattern with minimal cross-loadings and high loading on the one construct factor.

The value of some factor loadings is below a nominal cut off point of 0.65, but better than 0.5 on all factors. Therefore, the original variables were kept in a model (Schmidt and Hollensen 2006). PCA conducted finally on 38 items revealed a solution consisting of 10 factors which explain 68.5 percent of total variance. The number of factors was determined by the analysis of the percentage of variance explained and the Kaiser criterion (Aczel 1993).

For each construct, Cronbach's alpha coefficients were used to assess the internal consistency of variables. Their values are above the nominal cut-off point of 0.7 and may thus be considered to be reliable suggesting a good internal consistency of the ten constructs (George and Mallery 2003). PCA resulted in producing the total number of 10 factors, used for the further research:

- Factor 1: quality of the relationships established with supporting members, performing the non-logistics activities (degree of trust to supporting members, their knowledge of the specificity of other supply chain partners, integration with service providers generating a synergistic effect, involvement of providers in the integration, improvement of the competitive position as a result of interaction with non-logistics service providers, additional efforts offered by service providers to improve links with supply chain partners, contribution of the supporting members to achieve common goals, the process of communication with non-logistics service providers);
- Factor 2: quality of the relationships established with supporting members, performing the logistics activities (knowledge of the specificity of other supply chain partners, integration with service providers generating a synergistic effect, involvement of providers in the integration, improvement of the competitive position as a result of interaction with logistics service providers, contribution of the supporting members to achieve common goals);
- Factor 3: Frequency of evaluation of the relationships among supply chain partners (suppliers, customers, supporting members performing the logistics and non-logistics activities);
- Factor 4: Use of ICT in establishing the relationships among supply chain partners (suppliers, customers, supporting members performing the logistics and non-logistics activities);

- Factor 5: The level of investment in the development of relations among companies in the supply chain (suppliers, customers, supporting members performing the logistics and non-logistics activities);
- Factor 6: Commitment and frequency of the communication with the suppliers and service providers;
- Factor 7: Contribution of the suppliers and customers to achieve the competitive goals of a supply chain;
- Factor 8: Similar value system shared among supply chain partners;
- Factor 9: Synergistic effect generated as a result of interaction with suppliers and customers in a supply chain;
- Factor 10: Undertaking additional efforts in order to improve the relationships.

In the next stage of the study, supply chains were grouped into the classes regarding the relationships between material and information decoupling points. First, each examined supply chain was analyzed in terms of its structure. The examined company and its partners were assigned to an appropriate group constituting an upstream, middle or downstream supply chain structure.

As a sample consists of manufacturing and trade companies, the examined links were usually located in the middle or downstream in supply chains, respectively. It also determined a prevailing share of orders falling into the category of make-to-order, assembly-to-order, delivery-to-order and make-to-stock performed by investigated companies.

The first two categories are more typical for manufacturing companies whilst the latter two are more characteristic for trade companies. Then, depending on reciprocal location of material and information decoupling points, supply chains with a specific number of zones were identified. In order to compare the nature of collaboration between firms, supply chains with two and three zones were a subject of further in-depth investigation. It enabled to determine the effect of the location of material and information decoupling points on supply chain collaboration.

The analysis of the effect of the location of material and information decoupling points on supply chain collaboration. Preliminary findings and discussion

In order to analyze the effect of the location of material and information decoupling points on inter-organizational collaboration, cluster means for particular zones were calculated. They were based on factor scores of supply chain collaboration.

In order to determine whether the companies in the zones are different regarding supply chain collaboration ANOVA analysis has been performed. The three groups show significant differences ($p < .01$) in the ten factors: quality of the relationships established with non-logistics service providers ($F = 10.59$), quality of the relationships established with logistics service providers ($F = 3.33$), frequency of evaluation of the relationships among supply chain partners ($F = 4.59$), use of ICT in establishing the relationships among supply chain partners ($F = 6.56$), the level of investment in the development of relations among companies in the supply chain ($F = 30.07$), commitment and frequency of the communication with the suppliers ($F = 11.70$), contribution of the companies to achieve the competitive goals of a supply chain ($F = 17.90$), similar value system shared among supply chain partners ($F = 20.86$), synergistic effects generated as a result of interaction with suppliers and customers in a supply chain ($F =$

36.56), undertaking additional efforts in order to improve the relationships in a supply chain ($F= 32.07$).

The findings demonstrate that the location of information decoupling point has a significant impact on supply chain collaboration. All factor scores in zone 1 gained negative values. It may suggest that companies indicate the least positive attitude towards developing collaborative supply chain relationships upstream from information decoupling point. On the other hand, the importance of supply chain collaboration downstream from information decoupling point is rising to prominence. However, the attitude of examined companies towards establishing collaborative supply chain relationships may vary in zone 2 and 3 regarding the location of material decoupling point. Among many investigated dimensions of collaboration, use of ICT in establishing supply chain relationships, level of investment in the development of relationships, synergistic effect generated as a result of interaction with suppliers and customers and undertaking additional efforts in order to improve the relationships in a supply chain strike out as the most powerfully differentiating characteristics with the highest F values.

The use of Information and Communication Technology for establishing collaborative relationships is important for the companies located downstream from material decoupling point. This view is supported by the findings of M. Christopher (2000) who posits that information technology enables to share data among supply chain partners and can be fully leveraged through collaborative working.

The level of investment in the development of relationships also differentiates significantly the three zones. It is the most important factor for the companies in zone 3 which may suggest that agility and quick response to the market demand require investments in order to develop the collaborative relationships in supply chains. However, there is a consensus among the Authors that applying agility should not be confused with capturing surplus resources. There is still an issue of efficiency which is of a crucial importance for supply chains. So the relationships between downstream links should not result in maintaining excessive resources leading to the increase of operational costs for supply chains (Caridi and Cigolini 2002).

Another two significant factors are synergistic effects generated as a result of interaction with suppliers and customers and undertaking additional efforts in order to improve the relationships in a supply chain. Both factors have a very strong differentiating capabilities, however their importance for specific zones varies. The first one seems to be equally important for the companies in zone 2 and 3. This finding may suggest that generating synergistic effects from inter-organizational relationships is the aim of both groups of companies regardless of the position of material decoupling point. In the same vein, Vollmann et al. (2000) underline that developing synergy is a fundamental objective for supply chains. On the other hand, undertaking additional efforts in order to improve the relationships in supply chains is the most important factor for the links in zone 2.

The other factors of supply chain collaboration differentiate a research sample to a lesser extent. For instance, similar value system shared among the partners and contribution of the companies to achieve the competitive goals of a supply chain are almost equally important for the relationships in zone 2 and 3. This is consistent with the opinion of Rigby et al. (2000) who posit that responsiveness which characterizes the collaborative relationships in zone 3 is concerned with enriching customers by providing added value. This requires the organizations to adapt the solution-based approach to satisfy individual customers' expectations.

However, commitment and frequency of the communication with the suppliers is much more important for developing collaborative relationships in zone 3. It may suggest that achieving quick response to fast changing markets by the links located downstream from material decoupling point lies upstream in the quality of supplier relationships. The lead time of inbound supplier operations limits, most often, the ability of a manufacturer to respond rapidly to customer requirements. New product introduction time can be dramatically reduced through the involvement of suppliers in the innovation process (Christopher 2000).

Interestingly, the last three factors concerning the quality of the relationships established with logistic and non-logistics service providers, and the frequency of evaluation of the relationships among supply chain partners are the most important for developing the supply chain collaboration in zone 2, located between material and information decoupling points. This finding may confirm the previous studies on the role of outsourcing, core competency of supply chain partners and inter-organizational value creation (Womack and Jones 2003). For instance, a functionally organized firm may realize that it needs to outsource manufacturing of certain components, or ally with specific distributors in order to concentrate on operating activities delivering a superior value. The result of such changes is a network organization embracing a core company linked forward and backward to a limited number of partners. This kind of organization is a new approach providing an effective way of arranging and coordinating resources (Miles and Snow 1992).

The flow of value between the links located in zone 2 is also a subject of assessment in contemporary supply chains. The evaluation of the relationships among supply chain partners is based on the scheme of customer assessing the supplier started in the late 1970s. In order to focus on the way in which the value flows from one organization to another, relationship evaluation programs ought to be developed (Lamming 1996). In the light of the obtained findings, this is confirmed in collaborative relationships between supply chain partners in zone 2.

The obtained findings may suggest that the location of material and information decoupling points has an effect on the nature of supply chain collaboration in the three zones. However, the role of specific dimensions of supply chain collaboration may vary. Some of them are more characteristic for the relationships established among supply chain partners in zone 2 where efficiency and cost reduction play a significant role (e.g. similar value system shared among supply chain partners, undertaking additional efforts in order to improve the relationships in a supply chain, quality of the relationships established with logistics and non-logistics service providers, frequency of evaluation of the relationships among supply chain partners etc.). The other dimensions are more specific for supply chain collaboration in zone 3 where agility, speedy and responsiveness are the issues of crucial importance, such as use of ICT in establishing the relationships among supply chain partners, level of investment in the development of relations among companies in the supply chain, synergistic effects generated as a result of interaction with suppliers and customers in a supply chain.

The findings also revealed that the quality of relationships among the links located in zone 1 seem to be not important from the perspective of supply chains. This is primarily the result of limited information flow among supply chain partners and restrictions in the direct on-line access to undistorted data on consumer demand.

Limitations and further directions of the study

Apart from providing some insights into the effect of the location of material and information decoupling points on supply chain collaboration, the study also reveals some limitations and highlights the potential areas of future research.

Firstly, an investigation of the relationships between the location of material and information decoupling points is a very lofty but complicated task. There is a difficulty to conduct an in-depth analysis as there are various potential locations of these points. In practice, there are several material decoupling points in one supply chain related to different products, manufacturing processes or market places. Furthermore, these points are usually positioned at different locations along one supply chain. However, responding companies in supply chains perceive decoupling points and associated flows from the holistic perspective and do not refer individually to each point. Consequently, the companies would have difficulties with determining the characteristics of supply chain collaboration separately for each of material decoupling point and related physical flow.

An interesting issue which may require a further investigation is to consider a lean approach often referred to the push system and an agile concept linked to the pull driven activities. These aspects may result in providing an additional perspective of the analysis and would complement the findings of this study. Another important stream of the research is to conduct a similar analysis in all major links constituting a particular supply chain structure. Employing a wider perspective by taking into account other links in supply chain structure will definitely complement the obtained findings of this study and make them more objective, reliable and generalizable.

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